

State of California

Department of Public Health

Memorandum

To : Members of Task Group on Occupational
Exposure to Pesticides

Date : October 3, 1972

Subject: Interim Re-entry Periods

From : Henry Anderson

As of the date this is being written, information regarding decay rates, toxicity, registered strengths and formulations, etc., has not been received from PRD. However, it seems to me that certain general propositions may be made, on the basis of common logic, together with bits and pieces of information from the literature, from labels, from unpublished studies, from the University of California Agricultural Extension Service, and from the California Department of Agriculture's "worker safety time intervals."

- I. In the interests of everyone concerned -- manufacturers, users, and workers -- it is important that re-entry periods be recommended for all OPs registered for use on our five target crops. In California, for some reason, phosphamidon was omitted from the State Department of Agriculture's citrus "worker safety time intervals," although it has been registered for use against thrips since at least 1969, is recommended in the University of California's pest control guide, and is quite highly toxic. Perhaps it is only coincidental, but in the first quarter of 1971, before the re-entry periods officially went into effect, only 670 pounds of phosphamidon were used in California oranges, on a total of 430 acres; in the first quarter of 1972, after the regulations were in effect, nearly 4,000 pounds were used on over 2,600 acres of oranges. It would appear that, through the omission, this compound enjoyed a competitive advantage over other materials, such as dioxathion and ethion, even though the latter are considerably less toxic. This is unfair both from the standpoint of worker safety and of commercial enterprise.
- A. This general principle should apply even to materials for which a tolerance has not been established but is in process. For example, the annual citrus treatment guides issued by the University of California usually list several compounds "which may be used only on non-bearing trees or mature trees with no fruit present." In other words, a tolerance has been requested but not yet established. Workers may come into contact with residues of these materials in other ways than through picking fruit, however: tending nursery stock, pruning, etc.

- B. The general principle does not apply to materials which are registered for use on deciduous crops only during the dormant season. For example, ethion formulated with oil is not registered for peaches "after foliage or fruit begin to form." If the responsibility of the Task Group is to recommend re-entry periods only for those crop-activities "involving substantial contact with treated foliage," off-season activities such as pruning, raking and burning, training grape canes, etc., are outside our aegis.
- C. The principle of universality raises the question of whether we should include carbamates-- both for reasons of competitive advantage, and for reasons of worker safety.
- D. Once a set of re-entry periods is issued -- whether it be called "interim," "emergency," "temporary," or whatever -- it will have to be kept current just as surely as if the mechanism were permanent. In other words, whoever promulgates the "interim" list will have to keep abreast of new registrations, and issue re-entry periods for each based on the same criteria used in the original regulations. For example, as this is being written, registration of the use of dimethoate (Cygon) on grapes is pending. To its credit, PRD asked the manufacturer to determine the degradation of this compound and its oxygen analog on grape foliage as a pre-condition of the new use. To its credit, the company conducted a quite sophisticated study, and has made the results available to the Task Group on Occupational Exposure to Pesticides. This makes it possible to begin making calculations now, in anticipation of the time the registration of dimethoate will be extended to grapes.
- E. However, no worker safety time interval should be publicly promulgated until a product has been officially registered. To do otherwise may give unwary users the impression that they may begin employing a certain compound on a certain crop when there is still a question about tolerance, or a delay for some other reason. In California's "worker safety time intervals," naled (Dibrom) is assigned a 1 day interval under the heading "Peaches and Nectarines." In fact, this compound is not registered for use on nectarines. Its appearance in the State Department of Agriculture's "farm worker safety" regulations seems to give the implication that the Federal registration, University of California treatment guide, and other sources have been superceded.

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- II. To avoid any and all possible confusion, it would be advisable to maintain separate sets of regulations for each individual crop, even though two or more might overlap to a great extent. In addition to the instance cited above, there are certain other differences between E.P.A. limitations on peaches and nectarines. (. . ., the imidan (Prolate) tolerance is 10 ppm on peaches, 5 on nectarines; a 20 day pre-harvest interval is required for diazinon on peaches, 10 days on nectarines.) In E.P.A. regulations there are also certain distinctions between species of citrus. For example, ethion may be applied at the rate of 10 pounds AIA on oranges and grapefruit -- when a 30 day pre-harvest interval is observed -- but not on other forms of citrus. The label requirements for ethion at 7.5 pounds AIA call for a 21 day pre-harvest waiting period on lemons and limes, but none on oranges, grapefruit, tangerines, and tangelos. Such distinctions, however, do not appear in California's citrus re-entry periods. When worker safety time intervals are issued by the Federal government, it would seem advisable that there be reasonable congruence between such intervals and those already required for tolerance purposes. Unless E.P.A. modifies some of its tolerance requirements, there should be a separate set of regulations for each of the major forms of citrus.
- III. It is difficult to conceive of any circumstances which would justify setting picker re-entry periods which are shorter than those established by E.P.A. and carried on product labels for the purpose of enabling users to meet tolerance requirements. If pre-harvest intervals designed to protect consumers from residues on food products were adequate to protect harvest workers from residues on foliage, there would be no point in California's worker re-entry regulations, no point in the Federal Task Group on Occupational Exposure to Pesticides, no point in the citizens' petition to the U.S. Department of Labor, and no point in the response of OSHA and NIOSH to such a petition.
- A. Common logic would dictate that there is, in fact, a distinction between the two types of exposure, and a need for different sets of regulations. It seems obvious that harvest workers (and, in some instances, pre- and post-harvest workers), through intimate contact with tens of thousands of leaves each day, inhalation of vapors and airborne particles, and possibly even some ingestion, have enormously greater opportunity for exposure than the consumer who handles no more than a few dozen pieces of fruit in the market, and eats perhaps two or three pieces per day.
- B. In virtually every case where such common logic has been put to the test of controlled research, it has been corroborated: E.P.A. pre-harvest intervals, while sufficient to meet tolerance requirements,

are insufficient to meet the requirements of harvest worker safety. This was the case, for example, with azinphosmethyl and ethion in citrus. It proved to be the case, also, with phosalone, azinphosmethyl and ethion in grapes. Only in the case of naled in grapes, did the E.P.A. interval seem adequate to serve both purposes. In still other cases, such as dioxathion in citrus, although fully controlled studies of human effect have not yet been conducted, studies of "dislodgeable residues" appear to suggest that worker protection calls for longer waiting periods than consumer protection.

- C. Pre-harvest intervals shorter than those already in effect for tolerance purposes are not only a logical absurdity from the standpoint of worker health: they are also likely to prove hazardous to the economic health of growers. Such "re-entry periods" could create the mistaken impression that E.P.A.'s former limitations had been superceded; an entire crop harvested under this misapprehension could be condemned as over-tolerance.

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D. Notwithstanding all this reasoning from common sense, scientific evidence, and economic interest, the only "worker safety time intervals" currently in effect -- those in California -- are shot through and through with cases of shorter periods for the purposes of harvest worker protection than the intervals already in existence for the purpose of consumer protection. For example:

Crop and Compound	Days Required Between Last Application and Harvest	
	E.P.A.	California Department of Agriculture
<u>Citrus</u>		
Carbophenothion (Trithion)	30	14
Demeton (Systox)	21	None (not listed)
Diazinon	21	5
Dimethoate (Cygon)	15	4
EPN	30	14
Malathion	7	1
Naled (Dibrom)	7	1
Phosphamidon (Dimecron)	15	None (not listed)
<u>Grapes</u>		
Azinphosmethyl (Guthion)*	28	21
Carbophenothion (Trithion)	30	14
Demeton (Systox)	21	7
Diazinon	10	5
EPN	21	14
Ethion	30	14
Imidan	7	None (not listed)
Malathion	3	1
Naled (Dibrom)	4	1
<u>Peaches and Nectarines</u>		
Azinphosmethyl (Guthion)	21	14
Carbophenothion (Trithion)	30	14
Demeton (Systox)	30	7
Diazinon: peaches	20	5
nectarines	10	5
Dioxathion (Delnav)	**	30
EPN	21	14
Ethion	30	14
Imidan (Prolate)	14	5
Malathion	7	1
Naled (Dibrom): peaches	4	1
nectarines	***	1

* 1.5 lbs. AIA

** "Not after fruit begins to form"

*** Not registered.

All told, there are 40 possible re-entry periods involving registered organophosphate compounds and the three crops covered by California's regulations. Of these, 27 give harvest workers less protection than they enjoyed, in effect, without the regulations; 12 increase the protection of harvest workers, and 1 represents no change. Seven of the 12 increases were virtually dictated by the results of residue and/or cholinesterase studies. (In addition, the California regulations cover one carbamate, carbaryl (Sevin), in all three target crops. In two of these three cases, the waiting period required for worker protection is shorter than that required by E.P.A. for consumer protection.)

- E. If the Federal agencies pursue a philosophy as illogical and inconsistent as that in California, they will, at best, bring the concept of safe re-entry periods into disrepute, and, at worst, open themselves to a mandamus suit, under the Occupational Safety and Health Act, on the grounds that they have increased rather than mitigated worker hazards. In short, unless the Federal emergency (and, ultimately, permanent) worker safety re-entry periods are equal to or greater than tolerance re-entry periods, everyone concerned would be better off with things as they already are. With certain unaccountable exceptions (e.g., no time limitations at all on ethion on oranges at 7.5 pounds AIA; no pre-harvest interval for dioxathion on citrus), E.P.A.'s tolerance re-entry periods appear to lean sufficiently far in the direction of consumer safety to provide safety also for harvest workers.
- F. The petition by Migrant Legal Action Program, et al., states that "The Secretary shall . . . include within these (emergency regulations) any safety time intervals already enacted by the various states." This portion of the petition should be ignored, for it would place the Federal government in the untenable position of having to embrace some California re-entry periods which are dubious to say the least. The Federal regulations should specify, rather, that no state may promulgate re-entry periods which are shorter than the Federal standard -- leaving the way open to the possibility that states may, in response to peculiar local hazards, regulate more stringently if they choose.
- G. The relationship between E.P.A. intervals designed to protect consumers and OSHA regulations designed to protect workers can be drawn with assurance only in the period immediately before

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harvest. Since the concept of residue tolerances on fruit does not apply during thinning and other pre-harvest operations, there are usually no E.P.A. limitations during this period. Evidence suggests, too, that waiting periods adequate to protect harvest workers are sometimes more than adequate to protect pre-harvest workers. For example, a controlled study conducted by the University of California in June, 1971, found that ten peach thinners who began work 12 days after application of parathion sustained no plasma or erythrocyte cholinesterase inhibition. Apparently, the 21 day waiting period required at harvest could safely be modified downward to, say, 14 days prior to thinning. Similar conclusions have been reached in studies on apples conducted by the Wenatchee Experiment Station. It has yet to be demonstrated whether the same types of conclusions apply to the many pre-harvest cultural practices in grapes, and to pre- and post-harvest activities in tobacco.

It has yet to be demonstrated, also, why thinners are evidently at less risk than pickers. Among other hypotheses which have been advanced: perhaps the nature of the activity entails less contact with foliage; perhaps the relatively cooler climate in the thinning season is significant; perhaps workers, early in the season, have greater cholinesterase-regenerating powers than they do later. Whatever the reason for the differences may be, it would seem well to promulgate separate re-entry periods whenever there is substantial reason to believe that worker safety differs according to the type of crop-activity being performed.

- IV. Although precise quantitative extrapolations are not permissible, certain qualitative extrapolations from existing data may legitimately be made. Let us assume that a re-entry period for Compound A on crop X has been established through a controlled experiment (which is, in fact, the case for several compounds and crops). Let us assume that, although controlled experiments involving human subjects may be lacking, certain information on toxicity and longevity is available for all compounds on all crops (which is, in fact, the case). Such generalizations as the following would seem only fair and reasonable.
- A. If Compound B is approximately as toxic and approximately as long-lived as Compound A, given the same formulation, rate of application, and crop, it should not be assigned a shorter re-entry period.
 - B. If Compound C is more toxic than Compound A, and approximately as persistent, it should not be assigned a shorter re-entry period, or an identical one, but one which is longer.

- C. If Compound D is approximately as toxic as Compound A, and longer-lived, it should not be assigned a shorter re-entry period, or one which is identical, but one which is longer.
- D. If Compound E is both more toxic and longer-lived than Compound A, it should be assigned a re-entry period which is significantly longer.
- E. If Compound F is approximately as toxic as Compound A, but less persistent, it should be given a re-entry period which is the same or somewhat shorter.
- F. If Compound G is approximately as persistent as Compound A, but less toxic, it should be given a re-entry period which is the same or somewhat shorter.
- G. If Compound H is less toxic and less persistent than Compound A, it should be given a re-entry period which is shorter.
- H. If Compound I is more persistent than Compound A on Crop X, it is probably more persistent on Crop Y, too. Although the amount of the deposit, on any given day, might well differ between the two crops, the ratios should hold relatively constant.
- I. If Compound J is less persistent than Compound A on Crop X, it is probably less persistent on Crop Y, too.
- J. If Compound K is approximately as persistent as Compound A on Crop X, it is probably approximately as persistent on Crop Y, too.

To illustrate how these general propositions might be applied to specific cases: azinphosmethyl (Guthion), dioxathion (Delnav), and ethion vary considerably in oral toxicity, but in terms of acute dermal toxicity, which is most relevant to farm worker safety, they are very similar. From residue work done in citrus and grapes, it appears that dioxathion is the most persistent of the three, azinphosmethyl

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next most persistent, and ethion least persistent. At present, California and E.P.A. time limitations for the Task Group's five target crops are as follows:

Crop	E.P.A. Limitations			California Regulations		
	Dioxathion	Azinphosmethyl	Ethion	Dioxathion	Azinphosmethyl	Ethion
Citrus	No limitations	7 (1 appl.) 28 (2 appls.)	21 (13mons limes 7.5 lbs. AIA) 30 (oranges, grapefruit 10 lbs. AIA) Others, none	30	30	30
Grapes	30	0 (.75 AIA) 10 (1.125 AIA) 28 (1.5 AIA)	30	14	21	14
Peaches, Nectarines	>90*	21	30	30	14	14
Apples	7	7	20-60	No regulations		
Tobacco	Not registered	6	Not registered	Not grown in California		

*"Not after fruit begins to form"

A few of these relationships appear fair and reasonable: e.g., dioxathion in peaches has been assigned a longer pre-harvest interval than azinphosmethyl or ethion by both E.P.A. and the California Department of Agriculture. In the great majority of cases, however, there seem to be inequities which cannot be accounted for on the basis of residue or toxicity data. For example, ethion in apples has been given a far longer interval by E.P.A. than either dioxathion or azinphosmethyl, even when the dosage of ethion is substantially smaller than the other two (2.5 pounds AIA versus 6.0). By a similar token, it is difficult to understand why there is no E.P.A. limitation (other than a maximum of three applications per season) when azinphosmethyl is used on grapes at 0.75 pounds AIA, whereas ethion at 1.25 pounds AIA cannot be applied within 30 days of harvest. In the California regulation covering grapes,

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azinphosmethyl is given a longer waiting period than ethion, which is logical, but ethion and dioxathion are given the same, which is not. Perhaps most illogical of all are the intervals assigned in citrus, given the fact that more foliage residue work has been done in this crop than any other. California regulations give the same waiting periods to all three compounds, which cannot be reconciled with any empirical evidence. Whichever period is retained, there should be a gradient, running from ethion at the lower end, through azinphosmethyl, to dioxathion. If 30 days were retained for ethion, azinphosmethyl should be assigned an interval of at least 45 and dioxathion at least 60. If 30 days were continued for guthion, ethion should be reduced to, say, 21 days, and dioxathion increased to, say, 45 days. Or, if 30 days were to be kept in effect for dioxathion (probably the least tenable alternative in view of its persistence), azinphosmethyl and ethion should be lowered to something on the order of 21 and 14 days, respectively.

- V. Another of the grounds on which the California regulations are open to criticism is that some of their distinctions imply far more precision of information than is in fact available. For example, the California regulations give dimethoate (Cygon), mevinphos (Phosdrin), and TEPP 4 day re-entry periods in citrus, and diazinon 5 days; this suggests a fine line of distinction which would be difficult to justify in view of the fact there have been no controlled studies of any of these compounds on the foliage of this crop.

There is something to be said for grouping compound-crop combinations into a few broad categories when a firm data base for re-entry periods does not exist. This, indeed, is what both E.P.A. and the California Department of Agriculture appear to have done in all intervals over one week. We may assume that California's use of 14 days is intended to mean essentially the same as E.P.A.'s 15 days, and California's use of 30 days is the same, for all practical purposes, as E.P.A.'s 28. The problem arises only with compounds which are either extremely toxic but short-lived, such as TEPP and mevinphos, or relatively non-toxic, such as diazinon (dermally), and malathion.

One thing seems certain: for purposes of worker safety, there should be no crop compound combinations without any time limitations at all. E.P.A.'s registrations of naled (Dibrom) and malathion on tobacco, for example, carry no time limitations before priming or cutting -- presumably, in the one case, because the material is so evanescent, and, in the other, because its toxicity is so low. But when it comes to worker safety, the absence of any restrictions may tend to create the impression that it is acceptable to spray while workers are actually in the field. This is not an acceptable practice under any circumstances. For that reason, there should be no re-entry period shorter than 1 day, defined as 24 hours.

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The question is: how to apportion the waiting periods between 1 and 5 days? (Neither E.P.A. nor the California Department of Agriculture has ever proposed an interval of 6 days.) Would anything of great value be lost if all these crop-compound couplings were given a worker safety interval of 5 days? This procedure would certainly simplify the regulations. An explanatory text could be used to make it clear that the grouping was not intended to suggest that all the couplings were, in fact, identical, but only that all fell somewhere within the time period with an adequate margin of safety, and that under the present state of the art it would be misleading to attempt any finer gradations.

- VI. If there is to be but one "standard" for each compound in each crop, it should be long enough to protect workers from the heaviest application of that compound which is legally permissible. For example, for the control of citrus thrips and red mites, the University of California Citrus Research Center recommends half a gallon per acre of dioxathion (Delnav) 8 EC, appropriately diluted: i.e., four pounds active ingredient per acre. However, the registration permits applications as high as 12.5 pounds AIA. If only one re-entry period is promulgated for dioxathion on citrus, it should be sufficiently long to protect workers from residues of the 12.5 pound dosage; it will then automatically protect them from the effects of all lesser dosages.

However, there is a serious drawback to this procedure. If there is only a single standard, it may have the effect of forcing growers toward the maximum allowable dosage. Lesser amounts, coupled with an extended waiting period, may fail to achieve desired levels of control. Or growers may fear such a failure, and turn toward the heavier usage even if their fear is not objectively justified. It would be ironical indeed if the use of organic phosphorus compounds were to skyrocket as a consequence of worker safety regulations.

The way to avoid this untoward side effect is to issue re-entry periods which are graduated according to dosage. In the California regulations, there was one attempt to do so: intervals for parathion in citrus varied from 21 to 45 days, depending on cumulative poundage per acre per year. Strangely enough, the California regulations did not extend this principle to parathion in peaches, even though investigations by Milby et al. in 1963 concluded that "the observed illnesses were the result of residue accumulation related to total amount of parathion applied during the entire growing season."

Although regulations geared to amount of active material per acre (whether per application or per season) would complicate the work of the Task Group, the added work now might yield great benefits in due course of time.

VII. However desirable they may ultimately be, different regulations for different geographic areas appear to be a refinement which, for the moment, are not particularly crucial and not at all feasible.

- A. Industry has demonstrated that it can "live with" E.P.A. tolerance intervals which scarcely ever draw regional distinctions. If it be true, as has sometimes been hypothesized, that the frequent rains in Florida tend to wash off pesticide residues, they are washed from fruit as well as from foliage, and it is unfair that Florida citrus growers should have to honor the same pre-harvest intervals as those in the Yuma Valley or the Lower Rio Grande Valley. On the other hand, it has sometimes been hypothesized that organophosphates break down more rapidly in hot, dry areas -- in which case, it is unfair that growers in the semi-desert Southwest should have to abide by the same waiting periods as their competitors in other regions. Yet the fact is that E.P.A. regulations make no distinction between Arizona, Texas, and Florida citrus; California and New York grapes; Washington State and Virginia apples; Connecticut and North Carolina tobacco; and peaches in the many parts of the country where they are grown. And the further fact is that whatever "unfairness" this may entail has evoked no noticeable hue and cry.
- B. So far as is known, not a single foliage residue study has been conducted to date which tests the hypothesis that there are significant regional differences in decay rates. Such a study would have to control scrupulously for all other factors: precisely the same amount of material would have to be applied with precisely the same type of equipment on trees of precisely the same age and condition; leaf sampling, stripping, and residue analysis would have to be done by exactly the same techniques; etc. In the absence of any such evidence, it would appear most presumptuous to attempt any regional schedules at this time. It would seem particularly presumptuous in view of the fact that there are viable hypotheses in diametrically opposed directions: i.e., that damp areas should have shorter re-entry periods, and that hot, dry areas should have shorter periods.